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Canada Centre for Mineral and Energy Technology | Centre canadien de la technologie des minéraux et de l'énergie

MANAGING TECHNOLOGY TRANSFER AT CANMET

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MANAGING TECHNOLOGY TRANSFER AT CANMET

A Discussion Paper

I TECHNOLOGY TRANSFER AND GOVERNMENT POLICY

The announcement of the START Program in May 1983 and the allocation of $1.2 million for technology transfer mark the first time that CANMET has had a fund specially earmarked for technology transfer activities. This move is a clear signal that we are moving to a more active role in ensuring that our technologies find application in the market place. It is also a sign of recognition that transferring technology to a client deserves special attention and that, in some cases, it may require particular skills and resources to perform. While this transfer activity may be different from R&D, nonetheless like R&D it pervades the entire CANMET organization and occurs in every laboratory involving everyone. This paper outlines a set of steps towards a more systematic approach to technology transfer in CANMET.

The shift towards a more active interpretation of technology transfer by CANMET management is consistent with the new direction of government policy and priorities of the last few years. We can see this in the shift of NRC's policies, as expressed in its 1980 report, "The Urgent Investment", and the increased emphasis on NRC's PILP and IRAP programs. We can see this also in MSED's "Economic Priorities for the 1980's", published a couple of years ago, as well as in MOSST's Technology Strategy policy which was made public this summer. In all of these cases, there is a strong concern for using the scientific and technical resources of government more effectively to improve industrial competitiveness and productivity. It is a trend that is unlikely to change in the foreseeable future, even under a new government. As an instrument of government policy, CANMET has to reflect this shift in its activities.

o Results Are Not Enough -- They Have To Be Seen

In parallel with this shift towards greater concern for the technological welfare of our industry, there is another trend within the government which will increasingly affect CANMET. This is a move towards greater accountability for our resources. For example, in the last two years, CANMET has undergone an A-Base review, an internal audit, and a full review by the Auditor General. Another recent shift is the increasingly-detailed reporting to EMR senior management and central agencies, such as the ADM's semi-annual reviews, the activity approval documents, the five-year long term plans, the workplans, the growing scrutiny of the Panel on Energy Research and Development, and even the weekly significant events.

This push to show to our political and bureaucratic masters that we allocate and use the tax payers' resources effectively is likely to grow stronger. For CANMET, it will not be enough if the results of our R&D are useful. We will need, henceforth, to spend more effort and resources to ensure that our senior managers are made aware of this usefulness.

o Technology Transfer and CANMET's Mission

Technology transfer has a wide range of meanings depending on the organization, its purpose, and its context. For a country like Brazil, technology transfer is the process by which that country buys or obtains foreign technology and eventually adapts it to local conditions. Brazil has an elaborate set of laws, policies, and mechanisms to ensure it does not become overly dependent on other countries in this process.

To a large engineering company like Fluor, technology transfer is the way in which know-how and experience obtained in one area of the world on a given technology project can be effectively transferred to a client in another country, under perhaps a different set of circumstances.

For Boeing Aircrafts, technology transfer takes on a different shade of meaning. In order to adapt itself to the highly cyclical nature of the passenger aircraft markets, Boeing contracts more and more of its manufacturing to outside suppliers. This reduces the disruptive impact of the layoffs at their Seattle plant when the markets are down. For example, more than half of the components in a typical 747 are manufactured by outside suppliers. To Boeing, then, technology transfer means providing a supplier with the technology to manufacture components to the demanding specifications of Boeing quality-control engineers.

For CANMET, technology transfer has to be understood in terms of our own corporate objectives. The Mining, Minerals and Metals Technology Paper, recently approved by Cabinet, outlined CANMET's mission statement from which we can see three fundamental reasons for doing R&D:

These are:

1. To provide **policy** support for Ministers;
2. To ensure the **protection** of Canadians;
3. To improve the **productivity** of industry.

All three are important and all three have distinct outputs.

o **CANMET's Outputs**

For CANMET, technology transfer should be understood to mean the visible and successful delivery of the results of our R&D work to fulfill the three missions of CANMET. Broadly speaking, this means that our work in support of policy must satisfy Ministers and the various regulatory agencies. Our work in protection technologies has to improve -- and be seen to improve -- the health and safety of Canadian citizens and workers. Finally, our work in productivity technologies has to have -- and be perceived to have -- a truly beneficial impact on the productivity of industry in Canada. Each of these thrusts implies a technology transfer component. In the current government and economic climate, the one dimension that will have the highest visibility will be our

work directed at productivity technologies. It is on this aspect that the rest of this paper will concentrate.

In examining CANMET's outputs, a very real and substantial portion of our efforts is dedicated to what we call 'soft' transfer. It can include telephone advice in response to an enquiry from a mill operator, a visit by a senior industry executive to discuss ideas related to a new process, or the time spent by a CANMET scientist serving on a national safety standards advisory committee. None of the above activities is formally recorded in our activity approval documents. Yet all form very real contributions to the mineral and energy sector. Most of these activities are difficult to plan and are reactive in nature. When developing a technology transfer strategy, however, it is important not to overlook these activities and to ensure that sufficient resources are allocated to support them. Although they cannot be foreseen, when they do occur, every effort should be made to keep a record of the particular case or enquiry, of CANMET's response, and of the resulting benefit or impact.

Finally, not all our activities have to result in technology transfer. In order to maintain our role as a national R&D institution, we need to support certain core activities in order to maintain our expertise and scientific capacity. These include fundamental or basic research, and long-term speculative work. In the language of the private sector, these activities are referred to as the "cost of doing business" and are allocated to overhead.

II TOWARD A SYSTEMATIC APPROACH TO TECHNOLOGY TRANSFER

In dealing with technology transfer in the current context of government policy, we have to note the growing emphasis on developing technologies that will directly improve the productivity and competitive positions of the firms in our client sectors. This will require a concerted effort on the part of CANMET, to identify the technologies that industry will require over the next ten, twenty, or more years, to remain healthy

and competitive and generate benefits for Canada as a whole. All of this requires a conscious effort in planning. The following guidelines could help in devising a systematic approach to the planning of technology transfer.

o Understanding CANMET's Clients

In a mission-oriented context, the notion of the client, or user, or recipient of the technology is crucial. The client is the firm, the company, the plant, the mine, or the group of companies, or industries that will eventually adopt and use the technology to improve their production process. It may be the pipeline industry that can reduce inspection costs through a better metal stress analyzer. It could be the mineral processing industry that will enjoy the fruits of a new environmentally-safe and cost-effective extraction process. Or it could be the underground mine which, thanks to a new line of underground diesel equipment, will be able to reduce ventilation costs. The kinds of clients are as diverse as the technologies available in the mineral sector. What is important, is to have a systematic understanding of what that client needs now and will need in the foreseeable future.

To understand the technological needs of a particular industry, one needs to appreciate the nature and context of individual firms. The literature on assessing industries is well established, but for the sake of this discussion, a number of points are worth summarizing here. The first consideration is the size, dollar-sales volume, and overall structure including the financial structure of an industry. In addition, the management structure and its technical competence should also be examined. These parameters are generally useful in evaluating the strength and ability of a firm to adopt new technology.

Another consideration is an analysis of a firm's inputs (raw materials, their sources and substitutability and contribution to overall costs) and outputs (products). Closely related to this is an analysis of the process used, e.g., drilling, blasting and mucking, smelting and refining, or melting. Each industry in CANMET's

portfolio is resource-based and is involved in transforming a raw material (ore, metal scrap, fuel) and upgrading it to a higher value product through a specific process. In evaluating the technology of that process, it is important to identify the costs of the major production steps. This should be followed by an assessment of the potential for technological improvements and cost reduction and an identification of the technological gaps, e.g., what technologies need to be developed, as opposed to those that can be purchased off-the-shelf.

Finally, it is essential to examine all of the above in the context of that firm's national and international market, its competitors and its buyers. It is particularly relevant here to have an appreciation of the factors which will allow the firm to compete successfully ten or twenty years in the future. Will it be lower production costs? If so, which component of these costs can be reduced? Will it be lower prices,improved quality, higher specifications, or better service? These should give an indication of where productivity improvement efforts could be directed. Out of such an analysis, one can obtain a good idea of what the technological and R&D priorities should be (as opposed to financial, labour, or marketing). What remains to be established is whether the client firm can purchase the technology off the shelf, develop it by itself with its own R&D facility, or develop it cooperatively with government, i.e., CANMET or NRC or a provincial research agency.

In preparing the Mining, Minerals and Metals Technology Paper, it became apparent that while some individuals have a very good grasp of some problems in certain sectors of the industry, there was no systematic effort at an overall understanding of our client industry and its technical problems as a whole. This lack or absence may harm CANMET in the longer term in establishing its program and priorities.

o Using Our Intelligence Sources More Effectively

There are a number of vehicles that are already in existence in CANMET for achieving a systematic understanding of our clients'

technological needs. The most obvious ones are the NACMMR Committee and Subcommittees. While the main role of NACMMR to date has been in vetting our program, more effort could be made to use this vehicle to generate new ideas and new thrusts. NACMMR could be used to develop or provide a sounding board for state-of-the-art reviews, and time could be allotted at future meetings to allow for such discussions.

Another important element in developing an understanding of industry's needs are the numerous contacts that scientists have with industry through correspondence, conferences and meetings. These contacts are vital and important. However, more effort can be put into pooling the understanding and intelligence derived from these contacts to develop a systematic understanding of where an industry is going.

A third vehicle for obtaining industry intelligence is survey contracts including literature surveys, market surveys, and state-of-the-art reviews. With the new technology transfer fund, the frequency of these client-assessment studies should increase.

An important new kind of study in CANMET which will undoubtedly provide valuable insight into the needs of industry, is the joint CANMET-MPS study on a strategy for the non-ferrous smelter industry. This is one of the first times that scientists, economists and environmentalists from several government departments as well as industry are getting together to study in depth the requirements, opportunities, challenges and threats of an important sector of our client industries. The progress and results of this study should be watched carefully to determine if this approach can be applied to other areas of CANMET activities.

Efforts to understand our clients might also take the form of periodic papers, say, on the coal mining industry, the foundry industry in southern Ontario, or the state of boiler manufacturers in Canada. The last example is pertinent, since it is likely that it will be an industry like the boiler-manufacturing industry which will eventually commercialize fluidized-bed combustors.

This raises an important distinction between existing and well-established clients like the mining industry and the new industrial clients or consortia, that will have to be created in order to develop some of our strategic energy technologies.

The idea of review papers is not new, and CANMET has in the past produced some sporadically. What might be required in the future is a more systematic approach to pooling all the available sources of information, and to updating our view of the industry on a periodic basis. To be complete, such reviews should stress not only the technological gaps, but also the ability and organizational capacity for those industries to fill these gaps. This should include, as was mentioned previously, an appreciation of financial capability.

o R&D Priorities and Implementation

Given that we now have an overview of a sector's technological requirement and its abilities or lack of them to fill it, the appropriate R&D can be selected and performed by the Divisions. CANMET has, through the Research Program Office, a well established mechanism for selecting and monitoring R&D projects. This has been documented elsewhere and will not be discussed here. Suffice it to say that it is considered to be one of the better systems among federal departments.

o Evaluating and Packaging the Technology

In considering the mechanisms for the actual transfer, it is useful to consider what is in the technology package and what we are transferring. Is it a black box or a new instrument? Is it a new extraction process that will require a green field plant? Is it a new information system for modelling and simulating a plant process? Or is it a new approach for modifying existing process technologies? Knowing what it is that has to be transferred to the industrial client is a useful step to selecting the most effective channel or vehicle for that transfer. In some cases we may have a fairly good idea of what that package will

look like before the R&D has even begun. That perspective, in some cases, can be useful in determining the direction and form of the R&D work. In other cases, the shape of the technology package will not be known until the development is completed.

Equally important is deciding when a technology is ready to be transferred. This milestone is not easy to determine and is as much a function of the technical feasibility of the package (will it work?) as it is of its economics (how much will it cost?). A good example is the kind of analysis required in assessing the twenty-six technology packages that were presented at Promotech'83, the first technology transfer fair in Canada. While in most cases we have demonstrated the scientific principle of the technique, the state of readiness for transfer to industry varies with each technology. For most of these twenty-six technologies, we still need to establish the engineering feasibility and likely costs. Then we need to take the existing R&D reports and the engineering and economic evaluations, and put together packages which a client industry can examine and decide whether it wants to proceed with. The packaging of a technology into a commercially attractive form is perhaps new to CANMET, but it will certainly be a good discipline from a project management perspective. It will be difficult to transfer any of these technologies to an industry without some serious evaluation and packaging effort. This effort should be recognized as essential, and appropriate resources should be allocated to see that it occurs.

o The Management of Intellectual Property

No discussion of technology packages is possible without mention of intellectual property. Sometimes reduced to the notion of patents and patent application, intellectual property is in fact a much broader concept and includes the principle of ownership and management of knowledge and know-how. The knowledge or technology resulting from R&D can be distributed free to all, sold, or licensed carefully to selected firms. There is a major controversy in government as to how

intellectual property resulting from government R&D should be handled. Some say that, because the R&D was financed with public funds, the results should be made public and freely available to all. Others argue that if an invention remains in the public domain, no company will touch it, because -- since it is public -- there will be no competitive advantage for any one in exploiting it. The latter group claims the fewer the firms that know about a technology, the more valuable it is (within limits, of course) and the greater the chance that the technology will be exploited and generate revenue. The difficulty with this argument is that it places government in the position of choosing monopolies or quasi-monopolies for technologies, which leaves it open to criticism from those parties that were not chosen.

One point is clear, however: the government record of successfully exploiting and commercializing a technology has been remarkably poor. To generate revenue, a technology has to be developed and applied by the private sector.

How this debate will be resolved remains to be seen. It could include a possible modification or even abolition of clause 1036 in all DSS contracts which vests in the Crown all rights to intellectual property generated by government contracts.

Another consideration related to intellectual property is patents. Again, going back to the notion that secrecy increases the potential value of an invention, there is strong interest in protecting a new invention, whenever feasible, with a patent. Patent applications have always been a sore point among CANMET scientists. But an invention that is not adequately protected, may lose the interest of a potential client. Efforts have been underway for some time in OTT to streamline this process. In brief, good management of intellectual property is a prerequisite for successful technology transfer.

III TRANSFERRING TECHNOLOGY AT CANMET

In 1977, the Technology Information Division of CANMET under Dr. Kanasy, identified no less than 14 channels or vehicles for transferring technology including publications, seminars, workshops, and so on. By far, the bulk of our information is transferred through our publication programs. CANMET has a well-established record in using these methods. Other methods are less obvious, but equally effective, such as targetted contracts and using consistently two sets of contractors to develop competitively a new technology as in the case of fluidized-bed combustion. Contracting-in, cost recovery and fifty-fifty shared costs contracts are proven ways in which CANMET has successfully transferred its technology and there are opportunities for strengthening these vehicles.

Another effective transfer mechanism is cooperative research carried out with industry. By working directly with CANMET scientists, industry personnel are directly exposed to new technologies and adopt them in their operations over time. Two good examples in the mining are the use of stress measurements and numerical modelling in mine planning and design.

The use of demonstration packages is also becoming more prevalent such as mobile pilot-plants. We have one mobile pilot-plant in CRL, Edmonton, with two more in preparation, and we have another mobile laboratory for PMRL's foundry section, as of the end of 1983. All four are relatively new to CANMET and may have a significant impact in their respective sectors in terms of on-site demonstration of new technologies.

The use of pilot-plants within our laboratories can be strengthened and publicized further. The new "CANMET Facilities" brochure published in support of the Minister's announcement of START will undoubtedly help in that direction. Now that technology transfer is an intrinsic part of CANMET's mission, we can expect that more resources will be available to transfer the results of our R&D and expertise. Already,

through START, CANMET has a $1.2 million fund for two years specifically to fund technology transfer. CANMET also has to take greater advantage of existing funding programs within the government that can be used to transfer and demonstrate new technologies. These include PILP, IRAP, IRDP and funds under the various federal-provincial General Development Agreements. The guiding principle here should be that good ideas will get funded eventually.

o **Factors in Choosing the Appropriate Transfer Vehicle:**

- The Cost of the Technology

What are some of the factors that may affect a client's decision to adopt or not to adopt the technology? If the technology package is a new metal extraction process that for all intent and purposes requires a green field plant, we can assume very easily that this will require an investment decision that could cost the client between $100 and $400 million. This size of capital investment requires a major commitment on the part of the client, and it may take several years before the client industry makes a decision. This scale of technology investment requires careful planning in terms of presentations, contacts, discussions and detailed analysis with the client's technical, middle and senior managers. Probably intermediate decisions will have to be made to invest in a pilot-plant, which may cost between $10 and $30 million. Such decisions ought to be anticipated, and the role of government as a coinvestor in such pilot-plants should be examined well ahead of time. Government can play, and often has done so in the past, the role of co-investor in such pilot projects. The availability of government funds for such projects is often determined by non-technical factors. For the CANMET scientist, this means that, even though for a particular period of time funds may not be available, a project that is considered valid and still requires large-scale investments, should be kept on the back-burner until a more opportune moment or time window opens up. As one senior manager of the department once said, "good ideas will always get funded eventually".

- The Technical Capacity of the Client

Other technologies may not need a large investment on the part of a firm, but only require learning a new way of doing things. Two good examples of this are improved cupola operations through better process control, and computer software for simulation of ore processing methods. The adopting of these technologies would require, in addition to the purchase of some new equipment and software, the training of operators in the new or modified procedures. The level of training will depend largely on the technological sophistication of the client firm. A company like Noranda, with large R&D facilities, will not need as much hand-holding as, for instance a cupola operator, with less than fifty employees in total. The appropriate mix of seminars, literature packages, in-plant training sessions and demonstrations should be chosen as a function of the technical capacity of the particular client.

- The Secondary Clients

The previous discussion centered on how to approach technology transfer, given a clearly identified client or sector of the industry. The unpredictability of research and development often leads to unexpected results and findings. When the Energy Research Laboratories started work on the upgrading of bitumen in the middle sixties, no one ever suspected that Petro Canada would be the principal client of what today has become the hydrocracking process. At that time, Petro Canada did not even exist. In other cases, as a result of work on a specific project, spin-offs are generated for which no obvious candidate can be found. In such instances we are faced with technology packages for which we have to find a client. A good example of this might be potential applications in the potash industry of work already done in stabilizing uranium tailings, or the application of CANCOAT. There is no mechanism for easily identifying these secondary clients. One mechanism currently being explored by CANMET is the use of technology transfer exhibitions such as Promotech where technologies are presented to a very broad audience. Other mechanisms may

simply be the insight and intuition of a bench scientist who may by pure serendipity stumble on a new application. What is important is that these technologies are not forgotten. A mechanism is needed to store and keep them readily available.

- **The Impact of the Technology on the Client**

In summary, it is important to appreciate what a particular technology will mean from a client's view point. This appreciation will affect the actual approach used to transfer the technology to the client. It will dictate whether we will choose a small seminar, a presentation that could involve the Minister, a publication, or in-plant workshops. There is no unique way of transferring technology. It is the combination of the client and the technology package that dictates the transfer strategy. In the final analysis, unless it is forced to do so by regulation, a firm will adopt a technology only if that decision will increase its financial value.

o **Planning for Technology Transfer**

While many of the above points may be self evident and common sense, nevertheless, it is helpful to think through these various notions before embarking on a R&D project. It is impossible to have clear answers to each of these points at the start of an R&D project. Nonetheless, we have found in reviewing a number of projects in CANMET that the more these questions are addressed at the start of a project, the better are the chances of success. One mechanism for addressing these questions is provided to the scientist through the technology transfer component of the project authorization sheets. This is the third year that these components have been required, and it may take another year or two before the benefit of this analysis is fully realized.

A good understanding of the technology transfer dimension at the start of a project should have an impact on how the R&D will be conducted. Such an analysis will help in identifying the

people who should be contacted during the research, so that they become aware of the work as it evolves and can have some input. It will help in identifying the resources that may be required once the project is terminated. It might also have an impact on how the contracted-out research will be managed, including the optimal choice of the contractor. All these considerations will improve the chances for success of a given project.

o **Funding Technology Transfer: START**

The special START technology transfer fund, available through OTT, is intended specifically to assist this transfer process. There is $600K budgeted for fiscal year 83/84, and the same for 84/85. There are four basic categories of projects that can be financed under this fund.

1. Client Assessment Studies

It was mentioned earlier in the paper that a proper understanding of a client industry and its technological needs is a **sine-qua-non** for successful technology transfer. Projects under this category can include state-of-the-art reviews, industry surveys, technology assessments and market studies.

2. Special Information Packages

CANMET has an extensive publications program, successfully managed by TID. There are, however, occasions that require a special package to ensure proper marketing of a technology. This could be an audio-visual presentation, a model, an exhibit, or a special unique publication, e.g. re-packaging of available technical information into a form more accessible to potential clients.

3. Workshops and Seminars

Frequently, the best way to communicate a novel development is through a meeting or session. The START technology transfer fund will support the costs related to holding training sessions, workshops, seminars and

other meetings with clients to aid in the dissemination of CANMET technology.

4. Costs Related to Management of Intellectual Property

The process of filing for patents has often been unsatisfactory. Contract funds are now available for defraying expenses associated with these activities, including any cost that could be associated with negotiating final licensing agreements.

It should be mentioned that the START technology transfer fund is still in its initial operational phase. Project categories should not be considered absolutely rigid and will evolve as a result of experience.

o Demonstrating Success and Project Review

The shift in government policy and the drive towards greater accountability will mean that there will be increasing pressure on CANMET to demonstrate the successful performance of our mission. Until recently, all that was needed was to show that CANMET was technically very competent and did work that was considered generally useful. This is no longer sufficient. We will be forced increasingly to demonstrate that the work that we do has a substantial impact on the Canadian society and economy. This means that we will have to monitor more closely how the results of our R&D are being used outside CANMET. We will need to evaluate the economic and social impact that our projects have two, three, four, five years after their completion. This will require more effective tracking of the impact on the profitability and competitiveness of our client firms directly attributable to CANMET's work.

At present, there is not a single document in CANMET that tells the whole story of a project: how and why it was initiated, how the R&D evolved, what happened, how the client benefitted from it, what revenues were generated, and what lessons should be learned from this example. The need for such a document has become increasingly pressing.

Some effort has been made by OTT to correct this. A good example, although an expensive one, is the benefit/cost analysis of CANMET's pit slope project conducted by the Queen's Centre for Resource Studies. It is not expected that all projects will undergo that detailed level of analysis. It is more likely that a much more qualitative and back-of-the-envelope evaluation will have to be performed, along the line of the thirty-five success stories prepared by OTT. These are short summaries of what happened in selected projects. A mechanism is currently being devised to ensure that this information is systematically captured, analyzed and presented in a way that is meaningful to our clients, senior managers and central agencies.

o **The Role of the Office of Technology Transfer**

It is now over two years since OTT was created. Amidst some uncertainty and controversy, the staff of 10 people went through some adaptation and evolution to the point where the key functions of OTT are now well established. Our most visible role to-date has been in the **policy support** role to the Office of the Director-General. A major output of this has been the coordination and writing of the Mining, Minerals and Metals Technology Paper, which was approved by Ministers last March and announced by the Honourable Judy Erola in May of 1983. A key part of this discussion paper was the announcement of a CANMET mission statement, as well as a two-year $5.1 million START program. Other policy support functions include representing CANMET on a number of interdepartmental and intergovernmental committees. OTT is also called upon by the office of the Director-General to perform a number of policy related tasks.

The second function of OTT is the **technology evaluation** role, performed by the former Engineering and Economic Evaluation group of MSL. This group has evaluated the economics of a number of mineral processing technologies in response to requests by Divisions and is currently involved in the non-ferrous smelters strategy study with MPS. A major resource in that group is the CANEVA

computer program for calculating the capital and operating cost of large mineral and other chemical processing plants.

A third role of OTT is that of **project review.** In this context, review refers to a post-mortem analysis, monitoring and cataloguing of successful and completed CANMET projects. To date we have conducted, through the Queen's Centre for Resource Studies, one major cost-benefit evaluation, and internally have performed a brief review of thirty-five projects within CANMET.

Finally, the major role of OTT is that of **technology transfer.** This role, which is still evolving, has to be defined in relation to the very well established role of laboratories. Clearly, technology transfer has to be executed and performed by the scientists in the laboratories. Of that, there is no question. The role of OTT is one of facilitator, of making resources available, and of helping scientists cut through the red tape in accessing the programs and funds to ensure that the technology is indeed transferred. The START program is the most visible tool for technology transfer. We are also responsible for monitoring, cataloguing and publicizing the successful performance of the transfer process. This is part of our project review function mentioned earlier. OTT's role is to strengthen the contribution of the scientist; that is where the credit ultimately belongs. The ultimate purpose of the Technology Transfer Fund is to ensure that this contribution finds its way to the appropriate niche in the economy and generates the maximum benefit possible.

IV CONCLUSION

In summary, while the technical and scientific competence of CANMET must be demonstrated and reinforced, we will need to do more than that in the future. The current shift in government policies and economic climate over the last few years is forcing us to be more systematic in showing how we achieve our mission and, more importantly, to demonstrate to others how well we are performing. It is this demonstration of success

that is of concern and by which we will be judged by those who control our funding. It is hoped the points mentioned in this paper will provoke the kind of discussion which will ultimately result in a better appreciation of CANMET's contribution to Canadian society by all concerned.

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